THE NORMAL SCHOOL QUARTERLY

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SUPPLEMENT No. 1

I. The County as a Unit of Study in the Schools of Illinois

II. Department of Geografy and the State Course of Study

By

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Illinois State Examining Board

For Teachers' County Certificates

July 17, 1914—Afternoon

ENGLISH.

For First Grade, High School, Supervisory, Kindergarten, and Special Certificates. Answer any eight questions.

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1. Use the following words correctly: like (preposition), lie, rise, lay, raise, sit, real, set, drive, ride, purpose, propose.

2. Relate some experience of your own that has interested you.

3. What definite facts about letter writing should students in the upper grades and high schools know? In what grade would you begin teaching letter writing? What definite instructions would you give to that grade?

4. Write a letter to a friend who has recently visited you and who will therefore be acquainted with your home and circle of friends.

5. What definite facts about the paragraph should students in the upper grades and high school know? In what grade would you begin to talk about paragraphing?

6. Suggest three subjects taken from geography, history, or nature study on which students in the upper grades might write compositions of three or more paragraphs.

7. Imagine two friends talking about a recent picnic. Write out the conversation.

8. Comment on some short story or novel that you have read, covering these topics: Setting, plot, characters.

9. Explain the thought in these lines from "The Vision of Sir Launfal":

"He gives nothing but worthless gold
  Who gives from a sense of duty;
But he who gives but a slender mite,
And gives to that which is out of sight,
  That thread of the all-sustaining Beauty
Which runs through all and doth all unite,
The hand cannot clasp the whole of his alms,
The heart outstretches its eager palms.
For a god goes with it and makes it store
To the soul that was starving in darkness before."

10. Mention a poem suitable for each of grades seven to twelve, inclusive.

PEDAGOGY.

For Second Grade Certificate select any eight of questions 1 to 10, inclusive; for First Grade, High School and Special Certificates select any eight of questions 3 to 12, inclusive.

1. Discuss the importance of the first day at school.

2. Discuss the importance of assignments of lessons. What should a good assignment include?

3. What may a teacher properly do to secure regularity of attendance?

4. What difference does it make how children sit, or stand, or walk? State how you undertake to help them in these respects.

5. How should a teacher go to work to help children break up bad habits?

6. How may you teach children to memorize so as to save time and undue effort?

7. What ideas have you to guide you in making a program?

8. Why is attention so important? Under what conditions can a child give good attention?

9. What is the purpose of drills? Describe a good drill in arithmetic.

10. Give the advantages and disadvantages of departmental teaching in the grades immediately below the high school.

11. Name three difficult problems of high school management and give your solution for them.

12. Discuss discipline in the upper grades compared to that in the high school.

Illinois State Examining Board

For Teachers' County Certificates

Kindergarten—Primary and Supervisory Subjects

July 17, 1914—Afternoon

THEORY AND PRACTICE.

For Kindergarten Certificate only. Answer any eight.

1. What are four of the fundamental impulses of the child between the ages of 4 and 8 years which the teacher of the kindergarten and primary grades may use to advantage in school work? Illustrate.

2. If you should teach number work in the first or second grade, what relation, if any, would it bear to other subjects of the curriculum? Illustrate.

3. Describe briefly two games suitable for each of the kindergarten and first and second grades, with reasons for your selection.

4. Upon what would you base the kindergarten program or course of study? Answer fully.

5. What practical suggestions can you offer which will tend to promote the health of the school children in your care?

6. How may the school be organized and work conducted so as to develop independence and control and reduce the necessity of discipline to a minimum?

7. Discuss the use of phonics in teaching reading. Indicate the advantages and disadvantages.

8. State fully what the kindergarten should do for the child in language training and show how this may be carried forward in the primary grades.

9. What are the requisites of a story which is suitable to use as educational material for young children? Give an example of such a story for each of the three grades, kindergarten, first and second. Name three sources of poetry for use in these grades.

10. Gardening, pet animals, and wild birds are suitable subjects for nature study with little children. Select one of these subjects and write a plan for teaching it in the kindergarten or one of the grades. Let the plan show the number of lessons you think necessary, the material to be brought in and your method of presentation.

EDUCATIONAL PSYCHOLOGY.

For Supervisory Certificate only. Answer any eight.

1. What is the general function of the nervous system? Show how this general function can be expressed by the terms: response, reaction, adjustment, adaptation.

2. Define instinct:

(a) How does it differ from and how resemble, (1) reflex movement, (2) habit?

(b) Give a classification of instincts on the basis of ends which they serve and underscore those instincts that are especially important to education.

3. (a) What is the fundamental law of habit building?

(b) Discuss the educational significance of habit.

4. Show how attention is related biologically to the needs of the organism. Define and illustrate passive, active and secondary passive attention.

5. Define memory: Distinguish it from perception and imagination. Illustrate the dependence of memory upon association, with special reference to the conditioning factors, recency, frequency, and vividness (including primacy).

6. What is meant by creative imagination? Formulate some general rules for developing and training creative imagination.

7. Give illustrations showing how concepts should be developed in the classroom.

8. Give an example of a case of reasoning. What principles can you state governing the training of reasoning in school children?

9. Give a statement of the problem of formal discipline. Explain the method used in testing the validity of the doctrine of formal discipline.

10. How can you justify placing educational psychology in the professional training of the teacher?

THE COUNTY AS A UNIT OF STUDY IN THE SCHOOLS OF ILLINOIS

INTRODUCTION

A thoro-going systematic treatment of the home locality from the standpoint of its geografy, history, and civics gives information of great interest and value to all who pursue such study whether child or adult. A correct understanding of the immediate environment is the surest guarantee that more distant regions will be interpreted in definit, concrete mental images full of life and activity. It will enable the student constantly to draw upon known conditions to interpret and explain the new conditions of other regions. A treatment of the home county is required by the State Course of Study in fifth year, first month, and such study may be made very profitable.

In geografy the natural features and industries of the immediate neighborhood of the school furnish excellent material for first-hand study and should be fully utilized in home geografy, and frequently drawn upon to make definit comparisons in intermediate and grammar grades.

In history and civics foundation for concrete thinking may be laid by a brief study of the exploration, settlement, development, and present governmental machinery of the home locality.

While there is general agreement that basic work must be done in our schools by means of a study of the home locality, it is not so clear as to what shall be the geografic extent of such study. Geografically the home locality is a part of the great natural region known as the Gulf Slope, or the Mississippi Basin; or it may be a part of the Illinois River Basin, or the Glacial Plains. These units, however, are too large for special consideration in the beginnings of the study of the home region.

Politically, the home locality is a part of the United States, the State of Illinois, the county, the township, the school district. The immediate environment of the school bilding should receiv careful study regardless of the artificial boundaries imposed by political action. However, the pupil has some first-hand knowledge of places and events beyond his immediate home region gaind by travel, by association with his elders, or by reading the local newspaper. The school district geografically and politically should be

made familiar thru school exercises. Beyond this the township is too vague and unimportant a unit to be given more than the briefest treatment.

An Illinois county is a unit of large significance. It is an important unit in the congressional district, and in the senatorial district. It has numerous important offises to which prominent citizens strive for election. One of its offisers, the county superintendent, comes into direct contact with all the school children. Other county offisers are frequently brought to the attention of the boys and girls in school or at home. In most regions there is developt a strong county consciousness. If strangers meet at state gatherings, they usually locate themselvs by naming their county. The county seat is the center at which taxes are paid, teachers' examinations past, county institutes held, hunters' licenses purchast, marriage certificates secured.

The county soil reports of the Agricultural Experiment Station show the influence of the county unit in scientific agriculture. The recent issue of county topografic maps by the United States Geological Survey indicates the same trend.

Geografically, county boundaries may be natural features as Lake Michigan, the Mississippi, Ohio, Wabash, Illinois, and smaller rivers. More often these boundaries are purely artificial straight lines crossing level country. However, each county of Illinois is large enough to afford illustration of a large number of geografical features on a scale worthy of serious study. Some of these are streams, valleys, basins, divides, hills, ridges, moraines, plains, and many associated features. Culture features are represented by roads, railroads, villages, and cities. Industries are found in local stores, factories, mines, and quarries.

An understanding of these local features enables the pupil to think such topics more correctly and vividly with respect to distant regions. He will be greatly aided in seeing actual relationships between the books he reads and the real things about him. In any study of the features of the county, it should be made clear that these forms extend beyond the limits of the county in many or even most instances. If the county borders the Illinois river or is crost by it, the river should be studied thruout its entire length. The glacial drift of the county should be associated with that of the state and beyond. Railroads should be traced to

their termini. Large cities outside but near the county should be studied in relation to the home county. By such study the county may be shown to be but a small area in the larger physiografic and industrial region of which it forms a part.

If the pupils appreciate the fact that the land on which they have their homes was occupied by Indians less than a century ago, and that discovery, exploration, and settlement have taken place during the last hundred years in their own county; if they are taught some of the interesting and instructiv facts of the history of their immediate home, they will have some basis of understanding more concretely the great movements in national and world history which are exactly the same as those of the home county on a larger scale.

If children are taught the political facts immediately associated with their school district, with the government of the village, city, township, and county, they will more redily interpret in definit mental images the civic organization of state and nation.

HOW MAY THE COUNTY BE USED AS A UNIT FOR SYSTEMATIC STUDY?

If the foregoing presents sufficient reason for a study of the county these questions naturally arise: How can the teacher obtain the necessary information for such study? Shall the teachers of the county endevor to do the same work, or shall each be left to his own resources? What shall be the county superintendent's part in procuring material and giving direction to its effectiv use in connection with the regular course of study?

It seems evident that the study must be developt by the efforts of those who are working in the schools of the county. If done by an outsider, the work immediately loses its local flavor. The work must be directed by someone who is intimately acquainted with the county unit as to its natural resources, its industries, its social life, the history of various localities, the possibilities of the community life within the county, and the best and highest aspirations of its people.

No other person in the county has so fine an opportunity to know the county from every standpoint, and to influ-

ence social and community development within the county as has the county superintendent. If he sets before himself the task of using his county as a unit of study in his schools, so as to bring to every pupil a correct and adequate understanding of the home locality in its relation to the great wide world, he will have a splendid work to perform.

If the county superintendent has a literary turn of mind, he can prepare the necessary suggestions and descriptiv matter as a means of recreation. If he has a strong executiv bent, he can secure the coöporation and assistance of the very best teachers of his county in organizing and preparing the material for the use of the teachers of the county. Articles printed in the monthly school paper of the county, or the county newspaper, to be combined later into a pamflet, offer a means of putting interesting and instructiv material before the teachers, pupils, and the general public.

SOME GEOGRAFIC RELATIONSHIPS AS FOUND IN ILLINOIS COUNTIES

The home geografy as outlined in the State Course of Study demands close inspection of the immediate home locality. This offers an opportunity to relate the home region to other regions in the county and beyond. The transportation lines within the county, the location of the cities and villages of the county, and the industries of the county, in country, village, and city, are all topics that may be studied concretely, and that find wide application thruout the state, nation, and world. A few of these relationships will be mentiond from the viewpoint of the county as a unit of study.

1. *The stream valley and the work of running water.*— The bildings of the Illinois State Normal University stand on a low ridge crossing the northern part of the campus. Rain falling south of the bildings is carried in one direction, that falling to the north drains in an opposite direction. Thus we have divides, slopes, and valleys. The valley to the south leads into a larger valley which may be followed to its junction with a larger valley and a little farther on to a still larger one. Still farther on the stream in this valley develops an excellent series of ox-bow curves. The banks, and at places the bare earth, furnish material for study of erosion in many of its forms. The study may be

made within a mile of the school. After making this journey in the field the pupils are eager to trace a drop of water from the campus to Sugar creek, then southwest across McLean county and Logan county to Salt creek, thence thru the Sangamon, Illinois, and Mississippi to the Gulf. This gives point and purpose to the study of the drainage of McLean county, by means of Kickapoo creek at Downs, Salt creek at LeRoy, Mackinaw river at Lexington. The relation of these streams to each other and to their main streams gives a degree of understanding to the study of more distant and larger streams not to be obtaind otherwise. It relates the county also to the regions beyond.

2. A study of the soil.—This topic as outlined in the State Course requires observation and study out of doors. At a gravel pit less than a mile from the Normal school a twelve-foot section of earth is exposed showing the thickness and arrangement of the black loam, silt (sometimes called clay), sand, and gravel. By taking samples of these and experimenting with them in vessels of water, a concrete knowledge of soil materials is obtaind. The application of this to the county would show that black soil on top, with silt underneath, is found thruout the county and over most of the state, especially in central and northern Illinois. The sand and gravel are not usually found beneath the silt so near the surface as in this gravel pit.

3. Transportation lines and the location of cities of the county.—This topic is well illustrated by an article on railroads in the December number of the Woodford County School Bulletin, from which the following is quoted:

"The first railroad to be constructed thru Woodford county was the Illinois Central in 1852. Four towns soon sprang up along this line. Minonk, Panola, ElPaso, and Kappa. The operation of this road servd to open a wide territory that previously was practically unsettled. The broad prairie was soon a scene of activity.

"In 1855-56 the Toledo, Peoria, and Western Railway was constructed, crossing the Illinois Central at ElPaso. Other cities soon sprang up along this road, among these being Eureka, which had previously had its beginning a mile south of the present location of the business portion of the city.

"The construction of this road along its present right of

way was a source of disappointment to at least two villages in the county, for Kappa and Panola had hoped to be the points at which the new road would cross the Illinois Central. The crossing at ElPaso gave that city a prestige and advantage that neither of the neighboring villages enjoyd.

"The river traffic merely touches the western boundary of the county. An elevator is located on the edge of the river at Spring Bay. Boats stop at Spring Bay during the season for passengers and also to deliver freight. Before the railroads became so numerous this traffic was of more importance than it is at present."

Only a portion of this excellent article is quoted above. The article mentions all the railroads of the county and shows how Woodford county is connected by its transportation lines with Chicago, Peoria, St. Louis, New Orleans, and other cities. The facts of this article are interesting and instructiv not only to teachers and pupils but to the general public. This article illustrates many of the principles of geografy. It enables pupils to answer intelligently such questions as these. Why was Woodford county settled slowly before 1850 and rapidly afterwards? Spring Bay was the most promising early settlement in Woodford county; why so small now? Why are Minonk, ElPaso, and Eureka the largest cities of the county? Why has Versailles, once a thriving village and the first county seat, disappeared entirely?

It is evident that such information is of great educational value, and leads definitly out into the larger fields of geografy. Why not use the material of the immediate locality for developing principles of wide application in geografy just as we use material within immediate reach for developing the multiplication table.

4. Distribution of population.—Population distributes itself according to the opportunities for securing the necessaries of life—food, clothing, shelter, Population is given as so many persons to the square mile. Thus in 1910 5,600,000 persons were living in Illinois on 56,000 square miles, giving an average density of 100 to the square mile; 92,000,000 people live on the 3,000,000 square miles of the United States, giving a density of 31 to the square mile.

Density of population applied to the county takes on a

personal interest which makes a good foundation for such study in larger and more distant units. Thus LaSalle county has 90,000 people on 1152 square miles or 78 per square mile. The Illinois valley crosses LaSalle county from east to west near its center, a distance of 30 miles. Along the Illinois is located a number of cities, and villages with numerous industrial plants. In a strip 30 miles long and 2 miles wide, or 60 square miles, the population numbers 36,000. Thus 40% of the population of the county is found on 5% of its area. This narrow strip across the county has 600 people to the square mile while the rest of the county has but 50. The valley has attracted the population because of the transportation facilities, coal, cement materials, glass sand, and advantages for various factories.

A study of an area and its people where the factors determining the distribution of population are matters of first-hand knowledge forms the best possible foundation for study and comparison of more distant regions.

A similar study of Lake county shows that a two-mile strip along the lake shore contains two-thirds of the population of the county. Only one village of over 1000 is situated away from the lake shore.

5. Topics common to all counties.—Such topics as the foregoing, and many others, find application in every county of Illinois. The material is at hand. It is vaguely in the conciousness of every citizen and every teacher. It needs only to be organized and made available for school use in order to become one of the most effectiv aids in school work.

Geografy always makes much of the four great industries of the human race—agriculture, manufacture, mining, commerce. No region is understood geografically unless its relation to these four industries is clearly perceivd both from the standpoint of natural resources and man's activities. The relation of man to the region in which he lives is the key to every geografical study of every region large or small. If the child is taught to use his own experience and that of the community of which he is a part, in perceiving these simple but fundamental relationships, he has a good fund of organized knowledge as a foundation for the study and interpretation of more distant regions.

AN OUTLINE FOR THE STUDY OF THE COUNTY

This whole question of county study has taken form in the mind of the writer because of the requests of county superintendents to present at institutes concrete studies in Home Geografy, with application to the teaching in a particular county.

Each county is a separate unit from every other county, but there are necessarily the same fundamental topics which are applicable to all counties. At the request of county superintendents, the following outline has been prepared, and is being used at present for the development of the study in some counties of the state. The outline is offerd as suggestiv only. It may be enlarged, diminisht, or changed to meet the local conditions.

Topical Outline for Study of the Geografy, History, and Civics of a County in Illinois

I. Introduction.—A statement of scope, purpose and use of the work from standpoint of school pupils and the citizens of the county.

II. Location.—A simple statement, but so comprehensiv as to serv as a model of full geografical location.

III. Area and population,—so stated as to cover the usual form of presentation for a geografical area.

IV. Cities and railroads.—1. Name and give population of all villages, cities, and other settlements, in tabular form, in order of population; date of settlement may be included. Brief description of the location in county.

2. Full names and location within county of all railroads, giving extent of each railroad or railway system represented in county. Show relation to large commercial centers.

V. Climate of Illinois related to the county under consideration.—1. Give specific directions for study of wether in school, and for one month in each season, indicating how to keep individual records and to make a summary at end of a month's observation.

2. A clear, simple, but instructiv account of the climate, including winds, rainfall, and temperature. Some tabular reports from county or nearest Wether-Bureau Station will be to the point.

VI. Surface features and natural drainage.—1. Give specific directions for study of the work of running water applicable to any region of county.

2. Describe the surface of the county so that pupils may come back to it as a model of descriptiv treatment of a geografic area.

3. Describe original distribution of forests and prairies in the county. (See Educational Bulletins of the State Geological Survey, Urbana, Ill.)

VII. Soils and artificial drainage.—1. Give specific directions for study of soils, bring out their formation and some experiment with clay or silt, gravel, and loam.

2. Describe the soil areas of the county (see Agricultural College Bulletin 123), giving characteristics, suitability for crops, value per acre.

3. Describe levees, open ditches, and tiling.

VIII. Farming, or agriculture.—1. Give directions for study of a well-kept farm of the neighborhood. Make a map of farm showing bildings, fields, and crops. Several maps, one for each of four years will show rotation of crops well.

2. Describe the agriculture of the county showing chief crops, yield per acre, total yield, etc., from government reports; side crops, fruits, truck farming, methods of farming, etc.

3. The work of the Agricultural College, Urbana, Ill.; its bulletins and how to get them; value to farmers; illustrations from county if possible; the nearest experimental plots, and their value to the community.

IX. Mining.—1. General description of the mineral resources—coal, oil, clay, stone, gravel, etc.

2. Definit description of the development of the mineral resources of the county; a model of treatment of the mining industry of a geografical area. Details of local interest may be brought out in a very instructiv way.

X. Manufacturing.—1. Each industry should be taken up and described from the standpoint of the county.

2. The treatment should be specific, and give sufficient general details to present a picture. The following topics may be suggestiv:

a. Location of factory.

b. Its organization and development—a brief history.

c. The raw materials.
d. The labor.
e. The processes.
f. Marketing the product.

XI. Commerce and transportation.—1. Select a country village as a simple type and describe its trade, the articles shipt out, the goods brought in, the facilities for handling, storing, and transporting. Show how larger centers are developt. Bring out relation of trade to transportation.

3. Show clearly the interdependence of groups of people, the necessity of coöperation, the unity of purpose and action necessary to bild up a strong community. Make this topic a model for study of large areas from the standpoint of commercial development.

XII. Summary of geografic factors influencing the present situation of the county.

XIII. A simple, brief history of the county,—involving only vital facts that citizens of the county would profit by knowing. It should cover important events so concisely that the school child can lern them and remember them.

1. The county before the white man's coming.
2. Early settlements.
3. Development of county.
4. County seats.

XIV. Local civics.—Here is an opportunity to do concrete work in civics by a study of the local units from the school district up to the county. The treatment should be clear, simple, but sufficiently comprehensiv to interest pupils in the importance and necessity of local government. These topics may be treated—

1. The school district: offisers,—how elected, number, duties, term. Who are they now? Do you know them?

2. The township: offisers,—how elected, number, duties, name present offisers.

3. The town (civil township): offisers,—same topics as under 2.

4. Village or city offisers.

5. County offisers.

6. Relation of local government to state government.

WORK NOW IN PROGRESS IN ILLINOIS COUNTIES

At the present writing five articles on the county have appear in the Woodford County School Bulletin. The series is to be continued during the present school year. Prior to the opening of school in September the completed work is to be publisht in pamflet or book form for use in the schools during the next school year.

In Lake county, a committee has been organized, various topics assignd to the teachers best fitted to treat them, and some material is now in typewritten form.

In LaSalle county several articles have been prepared on various industries and manufacturing centers of the county. These will find place in a systematic treatment of the county.

In Lake county the following list of topics was prepared by the county superintendent and offerd at the end of the day's program of a county institute to beginning teachers. Experienst teachers were not required to attend the lessons. The county superintendent led in the discussions. He believd that teachers should know local governmental plans, and be able to present them as a part of the work in civics. The discussions were applied specifically to that particular county.

The interest in local matters was evidenst by the fact that almost every teacher, beginner and experienst, remaind for all the lessons. That such instruction was appropriate and timely was indicated by the fact that much of this local information was new to many, even to some of the older teachers.

Survey system: base-line, principal meridian, correction lines, townships, sections, fractions of sections, school sections.

Township offisers: duties, election of.

School districts: how establisht; offisers of, how elected, duties; boundaries, how changed.

Money for support of schools: how raised, how kept.

Town government: boundaries of towns, how changed.

Offisers of the town: how elected, term; town meeting; supervisor, duties,—in the town, at the county seat; clerk,

duties; assessor, duties; collector, duties; road commissioners, duties; justis of the peace, duties; constables, duties.

Village and city governments.

County government: offisers.

Courts: grand jury; petit jury.

RECOMMENDATION OF THE HIGH-SCHOOL CONFERENCE

At a meeting of the Geografy Section of the High-School Conference which met at the University of Illinois in November, 1912, it was recommended that high-school geografy teachers of the state be encouraged to make special study of the geografy of local regions, and to prepare reports which might be publisht and used in the elementary and high schools of the state. It is hoped that this bulletin may be the means of stimulating teachers both in high schools and elementary schools to undertake such local studies. The county may be made the unit unless some other area or region is better adapted to the study contemplated.

The writer of this bulletin will be pleased to communicate with county superintendents, city superintendents, high-school teachers, and others who may contemplate such work as is outlined in these pages.

DEPARTMENT OF GEOGRAFY AND THE STATE COURSE OF STUDY

The study of the county, as outlined in the foregoing pages, is especially applicable to the State Course of Study for fifth year, first month. It also finds a place in connection with the history of Illinois.

The department of geografy in common with other departments of the Illinois State Normal University, adapts some of its various courses to the special needs of teachers who are to use the State Course of Study as an outline of work. A statement of some of the specific ways in which the courses in geografy aid in carrying out the state course seems appropriate in these pages.

SUMMER SCHOOL COURSES FOR 1913

During the first summer term, June 9 to July 18, seven courses are offerd, all of which bear directly upon some special phase of the State Course of Study. During the second summer term two courses are offerd. These are described on pp. 18 and 19 of the Summer School Announcement, which will be sent on request.

Course 41, Method in Geografy,—is pland to give a view of the course of study in geografy from fourth to eighth year inclusiv. A thoro examination of the course of study, the subject-matter by years, and the relation of each year to other years, give the teacher a helpful view of the entire subject. The study of a school textbook, field lessons, observational records, and wide readings in the library bring out the scope of the geografy work with methods of developing the various topics with pupils.

Such a comprehensiv consideration of the course of study is of special value to the country teachers who present to their various classes the entire course in geografy. Other courses in the summer school deal with somewhat narrower fields.

Course 43, Home Geografy,—deals specifically with fourth-year geografy as outlined in the State Course of Study. Teachers always agree that the fourth-year geografy work is the most difficult year's work to teach. This is true because so much of the work is based on making and recording observations, and interpreting them correctly. Fourth-

year geografy is a rich field for teacher and pupil alike. It is delt with in this course in such a way that teachers taking the course should find fourth-year geografy one of their strongest lines of teaching next year. The course is especially helpful to all teachers of home geografy whether they follow the state course, or any other course of study.

Course 44, Intermediate Geografy,—is adapted to the needs of teachers who have classes in both fourth- and fifth-year geografy. It will deal with fourth-year work more briefly than course 43, and will also cover the ground of fifth-year geografy. Teachers find difficulty in getting material for the study of fifth year, first month. Sources for such work will be studied. The base map, or outline map, so frequently referd to thruout the course of study, will be used in ways appropriate for fourth- and fifth-year work.

Course 46, Geografy of North America,—will treat quite at length all of the topics found in sixth-year geografy. In the new course of study the full sixth year is given to a study of the home continent. This course deals with North America in such a way that the work may be redily adapted to classes. It will also point out methods of study and presentation applicable to other continents, and thus open the entire field of sixth-, seventh-, and eighth-year geografy.

Where the plan of alternation is followd, eighth-year work will be taught next year. For this reason the summer school does not offer special courses covering seventh-year work. However, the courses in commercial geografy, and mathematical geografy will aid much in the seventh-year geografy.

Course 45, Mathematical Geografy, and course 47, Geografy of the Minor Continents,—offer very complete courses covering the eighth-year work of the State Course of Study.

The mathematical geografy will deal not only with the astronomical phases of geografy, but the facts of mathematical geografy will be applied to the geografical study and interpretation of regions. It will thus be made to serv in the study of each of the continents as a whole.

The topics of the eighth year, first month, of the state course will be fully developt, and the range of this course will be much beyond the brief outline of the state course. Teachers of experience who wish to study with some intensity this phase of geografy will find this course helpful.

The course dealing with the Geografy of Minor Continents is offerd for the first time with the express purpose of presenting the field of geografy as outlined in the eighth year of the course of study. The term, Minor Continents, is used to designate Asia, Africa, Australia, and South America.

This course will deal with subject-matter and method appropriate to the eighth-year work. It will include the study and use of textbooks, reference books, museum materials, and pictures most helpful in getting a teacher's working knowledge of these continents for effectiv presentation to eighth-year pupils.

So far as the course deals with South America, the work will aid in the seventh-year geografy.

Course 42, Commercial Geografy,—gives a view of the entire field of geografy from the industrial standpoint and is a good single course from which to obtain a large fund of information of great value thruout the course in the grades. This course will be of special value, also, to teachers who have the geografy work of the ninth year, which includes commercial geografy for the second half-year.

Course 39, Elementary Physical Geografy,—underlies all the other courses and should be taken as a first course in geografy in the normal school. It deals with many topics of fourth-year geografy. It covers the same ground as the ninth-year geografy for the first half year.

Teachers who have had a course in elementary physical geografy will find Course 40, Advanst Physiografy, a good course for further preparation in the teaching of physical geografy of the high school. Teachers of experience and ability may undertake the advanst physiografy even if they have not had formal courses in elementary physical geografy.

COURSES NOT GIVEN IN SUMMER SCHOOL

The foregoing courses, or their equivalent, are taught during the regular school year. Other courses in geografy are also given during the year, some of which courses touch the state course specifically while others are advanst courses such as the superintendent or supervisor should know in order to see the larger field of study in the subject of geografy.

A course in the *Geografy of Europe* applies directly to the seventh-year work of the state course.

A course in *Geografy Method* makes a study of subject-matter and method to enable those taking it to organize and develop the geografy work in a system of schools. Numerous standard courses, among which is the state course, are studied and compared.

In addition to the foregoing courses, a full year of more advanst work is offerd. This includes three courses —*General Geology, Climatology*, and *Conservation of Natural Resources*. This year's work is designd to widen the field of previous courses, and it also furnishes much material of value from the standpoint of the state course. It brings home to the student the wide application and practical bearing of geografic factors to man and the nation.

CORRESPONDENCE COURSES

For several years correspondence courses in geografy were offerd to teachers in activ servis. One course delt with seventh-year geografy and another with eighth-year as outlined in the state course. The teachers of the department conducted these correspondence courses as extra work for the purpose of experiment. More than 100 teachers enrold in the courses and a large number completed one or both courses.

The work consisted of 32 written lessons, four for each month's work as outlined in the state course. The excellence and high character of the work was far above our first expectations. Teachers completing the courses were a unit in considering the correspondence work of great value with reference to their scholarship, methods of study and teaching, ability to study independently, ability to use reference books, organization of material, economy of time, English composition, and otherwise. The experiment has proven successful from every standpoint.

Numerous requests for these correspondence courses have been receivd during the past year, but the courses have been discontinued because "extra time" was no longer sufficient for the demands.

If appropriations askt of the present legislature are granted, correspondence courses will be offerd to teachers of Illinois in geografy, and in other subjects.

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The Physical Sciences in Our Public Schools

By

FRED. D. BARBER

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THE PHYSICAL SCIENCES IN OUR PUBLIC SCHOOLS

PART I.—NEED AND PRESENT STATUS[1]

The most markt characteristic of the past one hundred years has been the marvelous achievments of science. During that period science has all but annihilated time and space. One hundred years ago people livd in isolated communities, and the events which occurd in one community became known in other communities only after long periods of time, if at all. Each community was largely independent of every other community. Today, the whole world is a single community. No people, or group of people, in the civilized world can longer liv by themselvs. The railroad, the interurban, the telegraf and the telefone hav brought the Atlantic and Pacific nearer each other than were neighboring villages a century ago. The ocean cable, wireless telegraf, and the modern steamship hav brought foren lands to our very doors. This is one phase of the achievments of science.

Science in the 19th Century

A second phase of the achievments of science is the change in all the activities of daily life. The modern home, with all the conveniences of modern life, little resembles the home of a century ago. Our present-day methods of lighting the home, of heating it, our sanitary arrangements, even our methods of obtaining food and clothing—all life activities about the home hav been completely revolutionized, and chiefly because of the achievments of science. Here again, no person livs an isolated life. Every person and every family is dependent upon the activities of many other persons and many other families. To at all understand our surroundings, and even the relations of man to man, of family to family, of community to community—in short, to fit into this modern world at all, one must necessarily hav a considerable knowledge of the living world and the physical forces about him. It is the social significance of science in modern life which givs it an ever increasing importance as a subject in our public school curriculum.

[1]For Analytical outline of discussion see page 20

The content of our knowledge concerning the living and physical world is increasing and multiplying with a rapidity and a certainty almost beyond the comprehension of man. For convenience, we divide our knowledge of the world of nature into many so-cald sciences. The student or teacher of science often confines his study of nature to some small portion of the entire field, and is even then quite unable to keep informd regarding the known facts in that small field, so rapidly is information concerning nature increasing. No real student of nature pretends to keep himself informd regarding more than a very limited field. No other branch of human lerning is increasing with anything like the rapidity with which science is increasing.

Ever increasing content of our scientific knowledge

The *applications* of science to the useful arts are also multiplying with such rapidity that it is useless for anyone to attempt to keep himself informd regarding other than the most common and useful of these applications. And yet, if one wishes to be clast as an intelligent citizen it is necessary that he be familiar with some of these common, most useful applications and that he understand fairly well the principles of science involvd. The present demand for more scientific agriculture, for more scientific housekeeping, for the use of scientific principles in the construction of bildings, in the construction and management of railroads and factories, in the management of municipal, state and national governments—all these demands arise out of a recognition of the fact that science servs useful ends, increases the efficiency of human endeavor, conservs human helth, and multiplies human happiness many fold.

No one denies that science enters into, and to a great extent even makes possible, the advancement of civilization along material lines. No one denies the great importance of material advancement in bettering the condition of mankind. No one of us is inclined to do without the conveniences of modern life, to liv again in the primitiv fashion of our forefathers. In theory we all grant that a knowledge of science is necessary that we may be intelligent citizens. In theory we all grant that in a very large mesure modern civilization and all that is most significant to the common people in the way of improved living conditions, of shorter hours of labor and greater facilities for recreation and pleasure which have come during the the past century—we grant that all these things depend primarily upon the achievments of

science and the dissemination of scientific knowledge. *With all this before us we can but be startled when we fully appreciate the fact that science, during recent years, has been receiving relativly less and less attention in our public schools.* It is our purpose to show that science study is declining rapidly, discus the causes of the decline, and suggest a remedy.

Slight opportunity offerd for the study of science

Systematic instruction in science is not generally being given in our public schools below the high school. But the elimination of pupils from school ranks is so great that comparativly few pupils reach the high school. Moreover, elimination continues unabated thru the high school and, worst of all, even those who do reach the high school for some reason are shunning science more and more.

According to the report of the Commissioner of Education for 1911 there were enrold in the elementary schools of the United States, public and private, 18,339,828 pupils; in the secondary schools, public and private, 1,131,466 pupils were enrold. There were, then, about 16 pupils in the elementary schools to 1 in the secondary schools. It is therefore evident that too small a proportion of the pupils remain in school till they reach the high school. It is a matter of regret that there are no satisfactory data showing with any degree of certainty just when these pupils drop out of school. Probably Professor Thorndike of Columbia University is our best authority upon this matter of the elimination of pupils from school. In Bulletin No. 4, 1907, entitled, "The Elimination of Pupils from School", he says, "I estimate that the general tendency of American cities of 25,000 population and over is, or was about 1900, to keep in school out of 100 entering pupils 90 till grade 4, 81 till grade 5, 68 till grade 6, 54 till grade 7, 40 till the last grammar grade, 27 till the first high-school grade, 17 till the second, 12 till the third, and 8 till the fourth." In another study of 16 of the leading cities of the United States Professor Thorndike found an average of but 33 per cent of the pupils entering the elementary school remaining thru the eighth grade.[1] The following table shows more definitly the rate at which elimination goes on in our public and private secondary schools.

[1] Report of Commissioner of Education, 1911, Vol. I, p. 124.

TABLE 1.—*Per Cent of students doing work in each year of the high-school course—public high schools and private high schools and academies—United States and Illinois.*[1]

1910—1911	1st Year	2nd Year	3rd Year	4th Year	Graduating
Public high schools, U. S..	42.79	26.73	17.97	12.51	12.18
Private high schools, U. S..	34.65	26.93	21.28	17.14	12.60
Public high schools, Ill.....	42.58	26.09	18.37	12.96	......
Private high schools, Ill.....	34.88	28.06	20.08	16.98	......

This elimination of pupils from our elementary and secondary schools is a matter of great concern to every person interested in the cause of education. While granting the inaccuracies incident to the gathering of data such as given in the table above, we must still conclude that these figures are doutless fairly close approximations to the truth, the data for the United States being reported from more than 10,000 high schools. Consequently, we can but wonder just what the causes of this dropping out of school are and whether something might not be done to lessen this elimination. It is not our purpose, however, to discus this question at this time but merely to call attention to the fact that if the teaching of science is to reach any considerable portion of the pupils in our schools that we must attempt serious instruction in science much earlier in the child's school life than is now common practis. Moreover, it is not contended that the teaching of science in the elementary school is on the decline; it is probably true that science teaching is slowly gaining ground in our graded and ungraded elementary schools. But the gain is painfully slow and the teaching is so ineffectiv that this gain falls far short of compensating for the decline of science in the secondary schools.

Decline of science in the high school

That the study of science in the public high school has been on the decline for many years has been apparent to close observers. That this tendency has not been brought forcibly to the attention of educators and the general public more often than it has is doutless due to the fact that reliable data were so difficult to obtain. The report of the Commissioner of Education for 1910 throws much light upon this subject. This report givs in tabulated form the percentage of students studying each of the high-school subjects

[1]Report of Commission of Education, 1911, Vol. II, pp. 1187, 1202 and 1212.

for the twenty years from 1890 to 1910.[1] The accompanying graphs, Fig. 1 and Fig. 2, show how the several subjects hav varied in popularity, or at least in emphasis, in the public high schools and the private high schools and academies of the United States. These graphs show that the foren languages—Latin, German, and French—hav all made notisable gains in both the public and private high schools; that high-school mathematics—algebra and geometry—likewise made considerable gains in both classes of schools; that civil government has made considerable gains in private secondary schools but has lost equal ground in the public high schools; that English literature, rhetoric, and foren history, hav all made remarkable gains in both classes of schools. In markt contrast, however, these graphs show that all of the sciences listed, without exception—physiology, physical geografy, physics, chemistry, geology, and astronomy—hav sufferd remarkable declines during the same period. It should be noted, moreover, that the decline of the sciences has been much more rapid in the public high schools than in the private high schools and academies. If the decline in percentage of students studying the sciences in the public high schools has continued to the present date at the rate it was going from 1895 to 1910, then astronomy and geology are alredy extinct as high-school studies If it is to continue at this rate of decline in the future, physiology will ceas to be studied in 15 years more, physics in 25 years, chemistry in 40 years, and physical geografy in about 50 years. To be sure, certain applied sciences, namely, agriculture and domestic economy hav lately been added to the course. But the percentage of students pursuing these subjects barely amounts to one-fifth the loss sufferd by the older, so-called *pure* sciences.

As is shown by the graph, the Commissioner's report does not giv the record of several of the subjects earlier than 1895. A comparison of the figures for 1895 and 1910 shows that as the science group of subjects declined, the language-history group gaind ground.

From these figures it appears that while the percentage of students in our public high schools studying the science group decreast 39 per cent in the 15 years, the percentage studying the language-history group increast 51 per cent.

In his report for 1911[2] the Commissioner of Education in reviewing the progress of the decade again calls attention to the

[1]Report of Commissioner of Education, 1910, Vol. II, pp. 1139, 1140.
[2] Vol. I, p. 9.

Fig. 1. Graph, Showing percentage of students studying each of the subjects in the public high schools of the United States during the twenty years from 1890 to 1910. From the report of the Commissioner of Education. 1910.

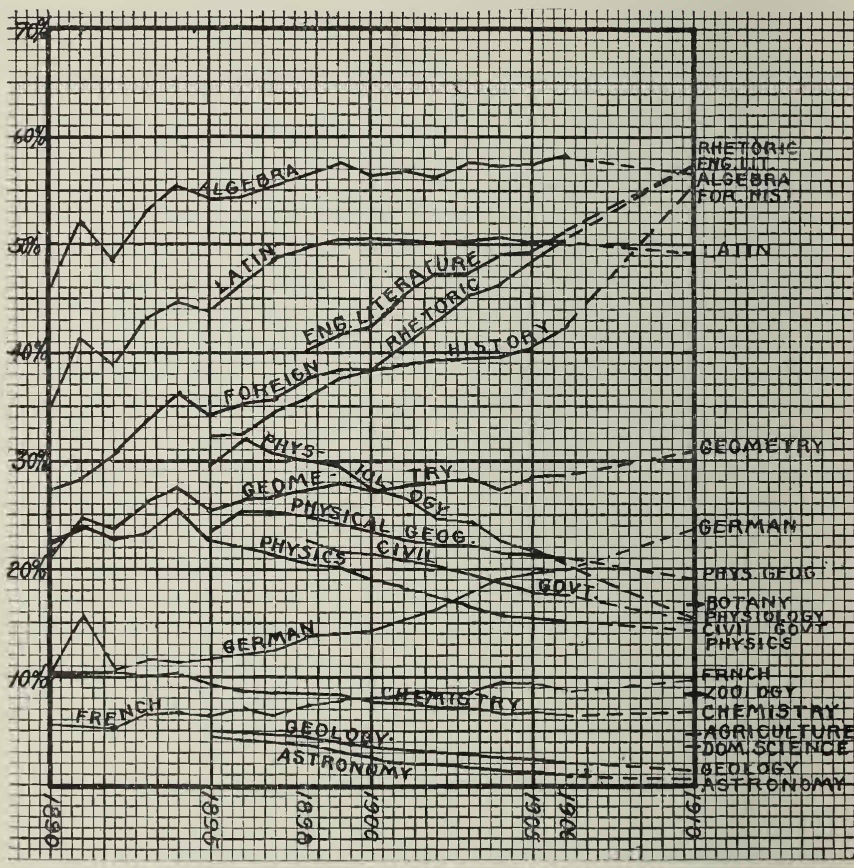


Fig. 2. Graph, Showing percentage of students studying each of the subjects in the private high-schools and academies of the United States during the twenty years from 1890 to 1910. From the report of the Commissioner of Education, 1910.

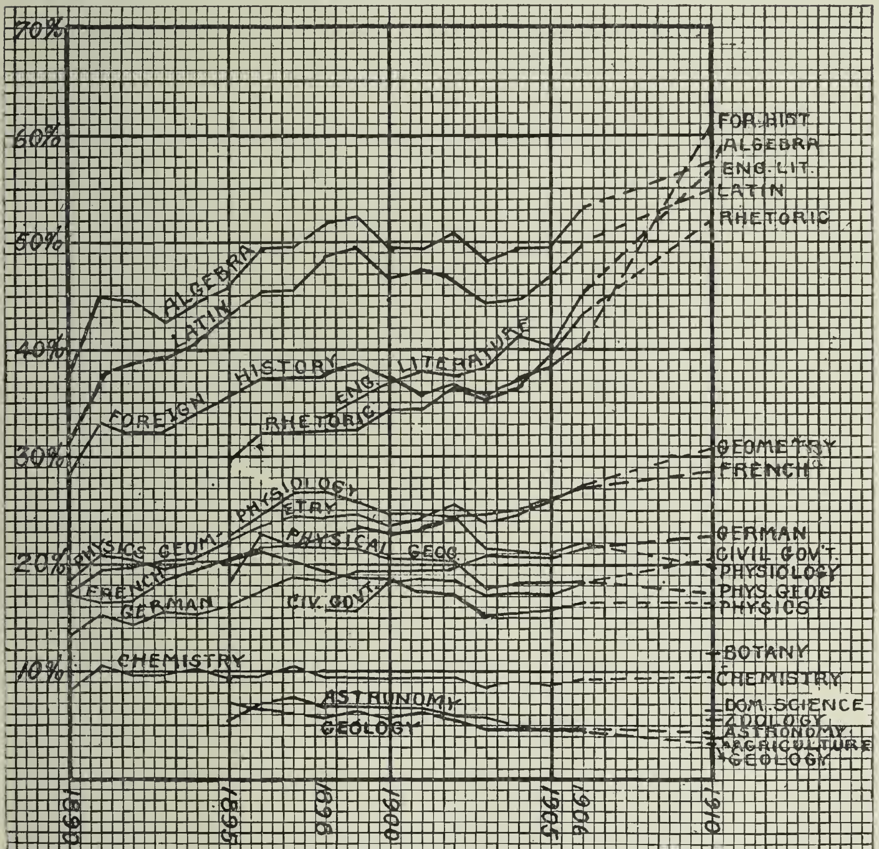


TABLE 2.—*Comparativ table showing percentage of students in public high schools—science group and language-history group—1895 and 1910.*

Science group	1895	1910	Language-history group	1895	1910
Physics	22.77	14.61	Latin	43.97	49.05
Chemistry	9.15	6.89	French	6.52	9.90
Physical geografy	23.88	19.34	German	11.40	23.69
Geolcgy	5.00	1.16	Rhetoric	32.05	57.10
Physiology	29.95	15.32	Foren history	34.33	55.03
Astronomy	4.79	.53	English literature	38.00[1]	57.09
Total	95.55	57.85	Total	166.27	251.86

studies which are receiving the greatest emphasis in our public high schools. In two parallel colums he shows the percentage of students pursuing the various subjects in 1900 and 1910. He says, "By comparing these two colums one can see that Latin is holding its ground; Greek is disappearing; French and German are gaining—German more than French; algebra occupies a large share of time and is stedy; geometry is gaining; trigonometry is rarely taken, but has not changed; *all the older sciences, rather strangely, are relativly falling off;* English and history hav gaind materially. The subjects of botany, zoology, agriculture, stenography and typewriting, and domestic science hav appeard in the list of studies in recent years, but no comparisons for the decade are possible."

Some reasons for the decline of science in our high schools are evident. First, so far as physics and chemistry are concernd,

Reasons for the decline of science

there has been a strong tendency on the part of teachers of these subjects in recent years to discourage rather than encourage any but strong students attempting the work. In fact, the work demanded of all students in the physics and to some extent in chemistry classes has been excessivly quantitativ and mathematical. Some strong teachers of physics and chemistry hav gone so far as to declare that they did not care to hav students undertake work in their classes unless they could do successfully this quantitativ, mathematical work. Ten years ago this attitude on the part of physics teachers, especially, was not uncommon. The result was that, where election was permitted, many students omitted physics and chemistry.

[1] Estimated—not listed till 1898

A second reason for the decline in physics and chemistry, rather closely related to the first, has been the tendency to push these subjects farther up in the course. Twenty years ago, physics and chemistry were frequently found in the second year of the high-school course. Today, these subjects are almost always placed as late in the course as possible; they are now almost universally third- and fourth-year studies. This change in position has been brought about in an attempt to secure the largest amount of mathematical training possible before reaching these subjects.

The third reason for the decline of the physical sciences at least, in the high school, is the fact that these subjects are taught as tho they were primarily and fundamentally college preparatory subjects. The emphasis is placed upon the development of laboratory technique and an attempt to teach something about every principle of the science. Little attention is given to the applications of those principles to the affairs of the student's own life. Now the boy or girl who is to pursue these subjects farther in college or technical school may need just the kind of a course that is usually given in the high school; but the student who must immediately upon graduation enter the world of industry, agriculture, or commerce, does not so much need this sort of training and instruction as he needs a knowledge of a limited number of the more important principles, and above all to see how those principles are applied to the affairs of his own life.

A fourth, and doutless the most potent, influence tending to steer the high-school student away from science study has been the influence and advise of the high-school principal or the superintendent. Such administrators, when teaching at all, are rarely science teachers. Science teaching and care of laboratories are not compatable with the handling of administrativ affairs. The efficient science teacher must devote long hours in his laboratory caring for apparatus, and correcting note-books or in the field gathering material. The administrativ offiser must devote long hours at his desk and naturally prefers to teach mathematics, language or history rather than science. Not being science teachers, administrators, as a class, are unable to keep in close touch with the advansment in science and science teaching. It is not surprising if they think of science and science instruction in the high school largely as it existed ten, twenty, or possibly thirty years ago. If these statements are true, it is

not to be wonderd at that they do not advise their pupils more strongly to study science. It is incumbent upon science teachers to demonstrate clearly the value of present day science teaching to their fellow teachers as well as to their pupils.

High-school science regarded as cultural and college-entrance subjects

There is evidence that the pupils and teachers of our high schools are regarding the sciences, more and more, as cultural and suitable for college entrance rather than as subjects particularly useful to the industrial worker or wage earner.

TABLE 3.—*Comparativ table showing percentage of students studying the sciences in public high schools and private high schools—1895 and 1910.*

Public high schools	1895	1910	Private high schools	1895	1910
Physics	22.77	14.61	Physics	29.32	16.46
Chemistry	9.15	6.89	Chemistry	9.79	9.38
Physical Geografy	23.89	19.34	Physical Geografy	18.15	17.26
Geology	5.00	1.16	Geology	7.08	3.46
Physiology	29.95	15.32	Physiology	22.34	19.85
Astronomy	4.79	.53	Astronomy	6.69	4.20
Totals	95.55	57.85	Totals	84.37	70.61

While Table 3 shows the percentage of students studying each of the sciences listed in the report for the twenty years, 1890 to 1910, other sciences were first listed in 1910. If we add these "newer" high-school sciences, our table will then stand thus:

TABLE 4

Public high schools	1895	1910	Private high schools	1895	1910
Totals, Table 3	95.55	57.85	Totals, Table 3	84.37	70.61
Botany		8.02	Botany		6.53
Zoölogy		16.83	Zoölogy		11.71
Agriculture		4.66	Agriculture		3.55
Domestic Science		3.78	Domestic Science		7.55
Totals	95.55	91.14	Totals	84.37	99.96

From Tables 3 and 4 the following facts become evident:

First.—In 1895 considerable more science was taught in the public high school than in the private high school; the revers was true in 1910.

Second.—Considering only the six sciences listed in Table 3, there was a decreas of 39 per cent in the public high schools in the 15 years, but a decreas of only 16 per cent in the private high schools.

Third.—Even if we presume that there was no instruction given in 1895 in any of the four sciences listed in Table 4 (*an unwarranted supposition*)[1] it still is evident that science in the public high schools has sufferd a loss of 4.6 percent in the 15 years while in the private high schools it has made a gain of 15.6 per cent.

In general, the students in the public high school are preparing for life's work while those in the private high school and academy are preparing for admission to higher institutions of lerning. These figures indicate that the sciences are better appreciated as a preparation for college than as a preparation for life's work.

Moreover, every one at all conversant with educational affairs is familiar with the pressure brought to bear upon our high-school officials and teachers to induce them to put all high-school work upon such a basis as to meet college entrance requirements. It is no secret that to get the small high school upon the accredited list is the goal sought by many high-school principals, and even by the school boards. It is to be hoped that in the near future we shall erect new standards of excellence for our public high schools, and that we shall then rate those schools largely according to the opportunity for training which they offer the boy or girl who steps from the high school into life's work. When that time comes, we may confidently expect practical science to gain ground rapidly in the high school.

Are the sciences really unpopular?

Professor Fisher of Cornell University, has attempted to show that possibly the figures quoted from the Commissioner's report may not mean that the sciences are really as unpopular as they appear to be.[2] As a result of a somewhat labored and technical argument based upon meager and unsatisfactory data, as Professor Fisher admits, he concludes that a portion of this apparent unpopularity is due to the fact that the sciences are not being given a fair opportunity in the high-school curriculum. He attempts to show but with some timidity regarding the certainty of his deduc-

[1]Altho botany and zoology are not listed in the Commissioner's report until 1910, it is a well known fact that these sciences hav had a place in most high-school curricula for many years.

[2]Science, N. S , Vol. XXXV, p. 94.

tions, that if all high-school subjects had been given equal opportunity with other subjects during the decade between 1894 and 1904, that Latin insted of gaining 14 per cent in popularity would hav lost about 8 per cent; algebra, insted of gaining 7 per cent would have lost about 6 per cent; geometry, insted of gaining 8 per cent would have lost 14 per cent; physics, insted of losing 34 per cent would hav lost 36 per cent; chemistry, insted of losing 31 per cent would have lost but 23 per cent; physical geografy, insted of losing 5 per cent would have gaind 5 per cent.

Professor Fisher does not suggest the possibility of there being anything wrong or lacking in the choice of subject-matter, nor does he suggest that the usual manner of presentation mightbeimproved. His solution of the dilemma in which science finds itself today is to offer courses in each line of science in practically each year of the high-school course. He says, "I am inclined to conclude from this table, that, in spite of the general impression to the contrary, American boys and girls like the sciences, both natural and exact, better than they like the languages, *provided they hav only as good a chance to get at them,* and the way to save the situation for science is to giv them the chance early in the course. I assert with confidence, that had 80 per cent of Dexter's schools[1] in 1904, offerd four years of chemistry and physics insted of four years of Latin, as they did, we should hav found the figures of percentage just about the revers, or even worse for Latin."

Impracticability of Professor Fisher's solution of the problem

It is possible Professor Fisher is right in his contention that if each of the sciences were offerd in the first year of the high-school course that the students would then be desirous of pursuing these subjects thruout the entire four years. The impossibility, however, of following his suggestion and thus offering four-year courses in each of the sciences now offerd in the high school, as is the case with Latin and English, is obvious. Moreover, a study of the needs of the students in our high schools, on the one hand, and of the subject matter we are now offering in these science subjects, on the other hand, can but lead to the conclusion that we are not now offering the kind of science which

[1]School Review, Vol. 14, p. 254.

warrants the expenditure of any such amounts of time and energy as would be demanded by such a program. While the contention that science instruction deservs more time and should occupy a more commanding position in our high schools than it now has, is well founded, there is little hope of much change until our school boards, our high-school principals, and especially the high-school teachers of science recognize the needs of the *majority* of the high-school pupils. When that time comes, science will be put upon a new basis; it will be given a new content; it will be made to serv the majority insted of the minority; it will then appeal to the pupils from the homes of the working classes as worth while, and there can be no dout that it will redily be granted the time and position which its true worth warrants. With the development of vocational tendencies in our high schools, science instruction must play its part—a leading part; but to do this, it must be adapted to new needs.

Purposes with which pupils enter the high school

According to a recent report of the Commissioner of Education,[1] our public high schools are thoroly democratic in character and ought to provide training for those students who are preparing to earn their living by manual labor as well as for those who are to enjoy the privilege of further training in the higher educational institutions. It is interesting to note that the students in our public high schools *are drawn from every class of people and are certain to enter every field of employment.* According to this report, the pupils in our public high schools come from the following classes:

10% whose fathers are professional men,
21% whose fathers operate farms worth over $5,000,
15% whose fathers operate farms worth less than $5,000,
10% whose fathers make $2,000 per year or more in trade or commerce,
14% whose fathers make between $1,000 and $2,000 in trade or commerce,
14% whose fathers are skild artisans making $750 or more a year,
16% whose fathers are unskild laborers.

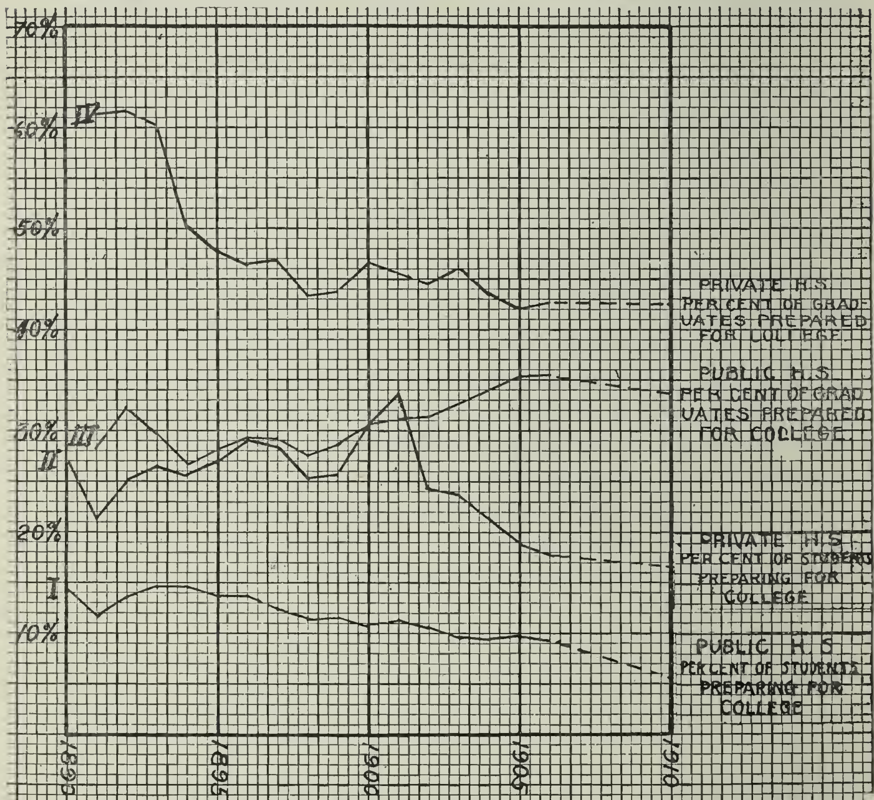
Commenting upon the present character of our public high schools, the report says, "The opportunity to advance in that type of work which leads to college, university, professional or technical school is enjoyd by all. *It is in this particular that we hav made good our boasted claim of equality of opportunity.*[2]

[1] Report for 1910, Vol. II, p. xxv.
[2] Italics are the author's.

Fig. 3. Graphs,

1. Showing percentage of students in the public high-schools of the United States reported as preparing for college. 1890 to 1910.

2. Showing percentage of students in the private high-schools and academies reported as preparing for college. 1890 to 1910.



3. Showing percentage of graduates of the public high-schools reported as prepared for college.

4. Showing percentage of graduates of private high-schools and academies reported as prepared for college.

While the high school is thoroly cosmopolitan in its membership, it is notisable that a much larger proportion of children from well-to-do families than from those of more moderate circumstances or from the families of the poor are found in our high schools. It needs also to be rememberd that those who do not wish to take the course which leads to college or professional school hav as yet very little provision made for their education. We may be proud of the great number of boys and girls enrold in our high schools, but we are justly ashamed of the meager opportunity afforded those who are to enter the industries."

According to the report of the Commissioner the proportion of students enrold in our public high schools with the purpose of preparing for college has been stedily decreasing during the past twenty years—from 14.44 per cent in 1890 to 5.57 per cent in 1910. The graphs, Fig. 3, show the variations in the percentage of students both in public high schools and in private high schools and academies who were preparing for college from 1890 to 1900, also, the percentage of graduates reported as prepared for college. If these figures, taken from the Commissioner's report, are reliable, they indicate clearly two facts: first, comparativly, a small percentage of students in the public high school use it as a preparatory school; moreover, the percentage who do so is rapidly decreasing; second, colleges and universities are generally redy and willing to accept the work now being done in the public high school as satisfactory preparation for college entrance.

No one can observ the fact that only 5½ per cent of the pupils in our public high schools are taking the course as a preparation for college while 34 per cent of the graduates of those schools are reported as prepared for college without having two questions come forcibly forward for answer: first, is it not true that our public high schools are now being run primarily as if they were college-preparatory schools; i. e., are not the pupils encouraged, if not forced, to pursue a college preparatory program, and is not the subject matter and instruction in each course pitcht chiefly to meet college-entrance requirements? Second, were we to fashion our high-school courses so as best to meet the needs of the 94 or 95 per cent who do not intend to go to college, would we follow essentially different lines in these matters? It is intended in this paper to discus these questions

only as they affect the teaching of science, and especially the physical sciences.

One has but to note the percentage of students studying each of the high-school subjects to see that the emphasis is being placed upon subjects which are not especially adapted to help the boys and girls who must go to work earning a living as soon as they leav the high school. As we have shown, English literature, rhetoric, algebra, history (other than United States), and Latin are the five subjects being pursued by the largest number of students in our high schools. No one douts the value of these subjects when pursued as culture studies. No one would seriously consider the elimination of most of the subjects in this group from the program of every high-school student. The only question is that of their superiority over the science group, which is receiving the least emphasis, as a preparation for entering the industries. They are pre-eminently college-preparatory subjects. It is the comparison of the emphasis placed upon studies of this type with the emphasis placed upon studies which are pre-eminently useful in equipping the industrial worker and wage earner for highly intellectual work and useful citizenship which is to be considerd here.

The ordinary high-school course is primarily a college preparatory course

The character of the modern public high school becomes most evident if we rather arbitrarily divide all the common high-school subjects into two groups, putting into Group I subjects which are commonly regarded as characteristically culture stud-

TABLE 5.—*Per cent of students pursuing subjects in the public schools of the United States, Year of 1909-1910*

Group I		Group II	
Latin	49.05	Physiology	15.32
Greek	.75	Physical geografy	19.34
French	9.90	Physics	14.61
German	23.69	Chemistry	6.89
Algebra	56.85	Botany	16.83
Geometry	30.87	Zoölogy	8.02
History (Foren)	55.03	Agriculture	4.66
Rhetoric	57.10	Household economy	3.78
English literature	57.09	Civil government	15.55
Total	340.33	Total	105.00

ies, or at least, which are regarded as desirable college-entrance studies, and into Group II an equal number of subjects which are generally regarded as of high value to the intelligent industrial worker and generally good citizen of the wage-earning class.

From these figures we see that 3⅓ *times as many students were pursuing the subjects in Group 1 as were pursuing those in Group 2.* Considering the fact that the subjects in Group II are especially adapted to the broad intellectual training of the boy who is to enter the industries or agriculture and to the training of the girl who is to be an intelligent home-maker and mother as well as to the training of both boys and girls in the science of helth preservation and general good citizenship—considering this fact, it seems clear that the subjects in Group II should receiv in our public high schools as much emphasis as those in Group I. When we note, however, that they are now receiving, in fact but ⅓ as much emphasis, some of us ceas to wonder that the charge has recently been made that our public high schools are near failures. Nor can we greatly wonder that the further charge has been made that it is useless to expect our public high schools, as now organized, so to readjust themselvs as to offer equal opportunity to the student whose education and training ceases with the high school and the student who is to enjoy a more extensiv training. It is little wonder that the demand for separate vocational high schools arose. Unless our public high schools are so modified as better to meet the needs of the masses of young people whose school training ceases with the high school the demand for separate vocational high schools is certain to prevail in the near future. And, if our public high schools are to continue to run primarily as preparatory schools, who is willing to say that the separate vocational high school ought not to be establisht?

Difference between a college preparatory course in physics or chemistry and a high-school course

There is an essential difference between an ideal college preparatory course in physics or chemistry and an ideal high-school course in those subjects. The ideal preparatory course in either of these subjects is simply the first year's work of a two- three- or four-year course in the subject. The ideal high-school course in either of these subjects is an abridged or abbreviated course which may be completed in the one year usually allowd to the subject. In the preparatory course the emphasis may very properly be placed upon the

mastery of a large number of the fundamental principles of the science and upon the acquirement of laboratory technique, omitting to a considerable extent the applications of the principle to the affairs of life. If the student is to continue the study of this particular science for one, two, or three years in the college or technical school the manipulativ skill he acquired in the high school will serv him well. Moreover, the application of the principles involvd in the science will become more and more evident as the course develops. In fact, in the technical school, that side will receiv the emphasis.

The ideal high-school course in physics or chemistry for the boy or girl who is to enter the industries or become a homemaker should be pland to meet existing conditions and attain definit ends. It is not a stepping stone leading to advanst work; it must be a complete course in itself. A large mesure of laboratory manipulativ skill is neither necessary nor desirable; some such training is, without dout, useful, but the pupil's time can be better spent in acquiring information than spent chiefly in acquiring manipulativ skill which after all, as we well know, is quite peculiar to the laboratory and foren to most of life's activities. But it is in another particular that the most striking difference is found between the ideal high-school course in physics or chemistry and the ideal preparatory course. In the ideal high-school course it is very essential that the student be led to appreciate the relation of the principle studied to the affairs of his own life. The high-school boy needs to see definitly how the principles lernd in his chemistry are related to the burning of coal in the furnace of which he has charge, to the burning of oil or gas producing the light by which he studies, to his efforts at gardening and agriculture, and to the industries in which his father and older brothers work. The high-school girl needs to see clearly how the chemical principles she lerns are applied to cooking and cleaning, to dyeing and dietary, to the handling of gasoline and gas stoves, to sanitation rather than to meditation. To confine instruction merely to the principles of the science without leading the student to see how those principles are vitally related to the common daily activities of the student and the community in which he livs, is to waste, in a large mesure, the time of the pupil and, still worse, to cultivate in him the habit of regarding as of value undigested or half-digested information which will soon be

completely forgotten or, at least, become so hazy as to be of little or no value to him in life's work.

Shall it be "pure" or applied science?

In order that any instruction given in school may be of lasting benefit to the pupils the facts or principles presented must be interwoven with the pupil's life experiences. At their best, our schools are open to the criticism of failing to dovetail sufficiently school life and home life. The result is that we find it necessary to repeat time and again the presentation of the principles and generalizations we attempt to teach. Teachers of physics and chemistry often assert that their students fail to handle successfully the mathematical problems and quantitativ relations which arise in the study of the sciences. Yet it is the experience of the teachers of the sciences that the students can generally perform the mathematical calculations with fair accuracy and rapidity *provided they are so coacht that they know just which mathematical process is required*. They can multiply, divide, extract square roots, solv problems in percentage and sometimes even in quadratics, *provided they are told just the nature of the problem and steered straight to the mathematical process required.* The difficulty is evident. Teachers of mathematics hav not yet been able to relate their instruction sufficiently to the affairs of the student's life activities. Mathematical principles and mathematical processes hav generally been well mastered by the student, but teachers of physics and chemistry hav abundant opportunity to observ the fact that those mathematical principles and processes are not always held in such a manner as to be available when most needed. If the principles and processes developt in the mathematics class were taught out of the material which constitutes the pupil's real environment—if the student were led habitually to develop mathematical principles and processes out of the activities of his daily life and to feel the mastery of those principles and processes to be a necessity for his best welfare —if mathematics were thus taught, is it not reasonable to suppose that when similiar situations again arise the pupil will be able to see more clearly the quantitativ relation involvd and therefore draw intelligently upon his knowledge of mathematics to furnish the solution?

High-school teachers of physics and chemistry, however, hav little if any justification in criticizing the methods of the mathematics teachers. It is equally true that the pupil is not usually

able to make applications of the principles lernd in his physics and chemistry classes unless those principles hav been developt out of, or in connection with, his actual life experiences. It is true that the student who is to keep straight on thru the college or technical schools will hav much opportunity in his later courses to work out the applications of the principles of physics and chemistry to practical affairs. But in the ordinary high-school course today the less favord student, who has no hope or prospect of receiving further training is also given courses which are chiefly "pure" science (perhaps a more appropriate term would be "sterilized" science), and then is sent forth into the world to work out the difficult relations of applied science for himself. *Generally this is just what he does not and can not do.*

Analytical Summary of Part I

1. The achievments of science hav made the whole world a single community. To be an intelligent citizen of the world one must have considerable knowledge of science.

2. Science has also enterd into almost every convenience of modern life; it affects life's activities at every turn. The social significance of science in modern life justifies the emphasis of science study in our public schools.

3. The content of our scientific knowledge is great and is increasing at a rate much faster than is the content of any other division of human lerning.

4. Altho, in theory, we all grant the dependence of modern civilization upon science, statistics show that our public schools are placing relativly less and less emphasis upon the teaching of science.

5. In the grades science is doutless slowly gaining ground, but in the high school the percentage of students pursuing the six sciences, physiology, physical geografy, physics, chemistry, geology, and astronomy has fallen off nearly forty per cent in the fifteen years from 1895 to 1910.

6. This decline of science is much more markt in the case of the public high school than in the case of the private high school. This indicates that the children of the welthy and well-to-do preparing for college are more disposed to study science than are the pupils of our public high schools, many of whom are the children of the laboring classes who expect to go to work after graduating from high school.

7. The public high school is cosmopolitan and democratic in its membership but practically the only opportunity it offers is that of preparing for college. At present it offers practically no special preparation for those who must enter the industries.

8. The demand for a separately maintaind vocational high school is the logical outcome of present tendencies in our public high schools. Unless our public high schools turn right about face and offer adequate facilities for the training of the nearly ninety-five per cent of the students who do not intend to go to college, the demand for the separate vocational school will prevail and ought to prevail.

9. The high-school sciences should be so taught as to show the pupil clearly how the principles developt are involvd in his own daily activities, or in the activities of the members of his family, or the activities of the community in which he livs. Otherwise the science taught is undigested or but half-digested, and is soon useless if not entirely forgotten.

Part II.—Suggestions Regarding a Course of Science Study With Special Reference to the Physical Sciences[1]

SCIENCE BELOW THE HIGH SCHOOL

Need of science in the elementary school

There is great need of much more science instruction in the elementary school than is now being given. The introduction of some work in science by the fairly well-prepared and enthusiastic teacher puts new life and spirit into the school. The child needs to hav his school hours enlivend by the introduction of exercises other than those of reading, writing and arithmetic. Most of the work in the elementary school is not closely related to the child's life activities outside of the schoolroom. When at play, at home or on the school grounds, and while on his way to and from school the child is in constant contact with nature. The skilful teacher can seize upon this fact and utilize the child's experiences at every turn. Practical science not only deals with a body of knowledge of great value to the child but it also, at the same time, if skilfully handled, adds much to the interest of the pupil in all his school work.

It is not necessary that the teacher be a skild scientist in

[1] For analytical outline see page 31

order that she may conduct science exercises of high value. She must, however, hav a clear idea of the purpose of the work

Preparation of the teacher

and must recognize and thoroly believ in its value. She should be willing unhesitatingly to put herself in the attitude of a lerner—of a student anxious to study into and solv, so far as possible, the many problems of nature which arise daily. This means that she must be willing to say frequently, "I don't know, but you and I will try to find out about it." If the teacher can thus acquire the attitude of a student along with the pupils, and will arm herself with the many excellent helps which are available, she will find that many of the problems which at first completely baffle her will soon be solvd redily. Finally, the teacher of elementary science who succedes best is the one who is willing to get out daily with the pupils upon the school yard, or into the neighboring garden or field, and occasionally into the nearest woods and there study at first hand the many interesting phases of nature. The teacher who tries this plan soon lerns to enjoy such trips. Such an attitude on the part of the teacher is certain to gain for her the favor of the pupils which, in turn, will greatly assist her in doing the more systematic work of the schoolroom. The teacher is certain to succede in her science teaching in the elementary school if she possesses the following qualifications:

1. She should hav the knowledge concerning elementary science provided by the ordinary high school.

2. She must hav a clear idea of the purpose of science work in the elementary school and she must believ thoroly in its value.

3. She must be willing to put herself into the attitude of a student along with the pupils and attempt to solv with them the problems which arise.

4. She must find it a real plesure to go out with her pupils into nature's field and there observ and study at first hand the common things of life.

It is, however, a fact greatly to be regretted that comparativly few elementary school teachers are thus equipt for the teaching of science. Superintendents and school administrators generally recognize this fact and are consequently slow to provide opportunity for systematic science instruction in the elementary school. At the present time neither superintendents nor elementary school teachers take science teaching in the grades very

seriously, and from present appearances it will be some time before they will do so.

The purposes of science study in the elementary school are briefly stated in a "Course of Study in Practical Science" recently issued by the Massachusetts State Board of Education. The principal aims to be kept in mind in this course are:

Purpose or object of science study in the elementary school

1. To hav the pupils appreciate nature and to wish to ask questions about natural objects and phenomena.

2. To hav the children acquire a knowledge of facts or experience that will help in their understanding of the natural laws acquired by later study.

3. To help the children understand their home environment and be interested in conserving home life in all forms.

4. To hav the children acquire a minimum of information which will help them to understand other subjects better.

It is not the purpose of science teaching in the elementary school to develop the *laws of nature*. The nature of the child's mind is reveald by the kind of questions he asks. The typical question askt by the child in the early grades is the *what* question. "What is this?" "What is that?" The answer may be, it is a kite. Gradually as the child develops he becomes interested in the *how* of things. His question then is, how do you make the kite fly? The final stage is the *why* stage. But it is a long stretch thru the *what* and *how* stages of the child's life. It is not until the child is well establisht in the high school that he persistently demands the *why* of things before he is satisfied. "Why does the kite fly? What holds it up? Just how do the forces act?" These questions come only when the pupil has arrived at a degree of maturity when he seeks the causes of things. When he does reach this stage of his development he is redy to grapple with the laws and principles of science, but this stage is not ordinarily reacht in the elementary-school period. In the elementary-school, therefore, science should be taught with a view of giving the child a knowledge of *individual things for their own sake*. At this time the child has little or no desire to generalize, nor can he do so successfully to any great extent if askt to do so. This is the period when the child is immensely busy gathering a vast amount of largely unrelated information. This information will be found to be the brick and mortar alredy on

hand when he gets to the stage where he can erect the structures we call the sciences.

Subject-matter to be used

It is evident from what has been said that no two schools can successfully use exactly the same subject-matter. Each school and each class should use the material with which the pupils in that school or that class actually come in contact in their ordinary daily activities. Since the purpose of the course is to explain the natural phenomena surrounding the children, it is evident that no cut and dried, specific and definit outline of material can be given. The general character of the material which may be used successfully, especially in rural schools, is indicated in the Course of Study for Common Schools of Illinois, pp. 199-215, Fifth Revision, 1912. Another excellent outline lately issued is the Course of Study in Practical Science for the First Six Grades of Rural Schools of Massachusetts, Bulletin No. 8, 1912.

SCIENCE IN THE HIGH SCHOOL

Transition from the grades to the high school

There is no dout about the first high-school year being a trying one. The pupil finds himself in a great mesure in a strange, new world. If he be a pupil from the eighth grade of the city school, he has been used to being in a room with forty other pupils with all of whom he was intimately acquainted, having been promoted from grade to grade with most of them. He has been accustomed to recite all his lessons to the same teacher. New subjects hav not often been taken up by him; his arithmetic, reading and geography hav been progressiv developments of the same general subjects as he advanst from grade to grade. Now he is thrown into a room with scores or even hundreds of others, the majority, probably, strangers to him. He recites his lessons to departmental teachers. Not only are his subjects new, but his Latin, German, algebra, history or English, are much more technical and exacting than were the subjects to which he has been accustomed. If he is a country boy, fresh from the eighth grade of the rural school, entering the small town high school his position is even more trying.

To put the freshman boy who is not particularly a book lerner into Latin, algebra, English and foren history, under circumstances such as those described above, is to invite failure and insure discouragement. Even permitting him to elect one

science of the establisht type, is not much of a relief. All the older, systematic sciences hav been so thoroly systematized and the emphasis is placed so strongly upon the generalizations, the laws and the principles that the tension is just about as strong with them as with any of the high-school subjects.

It is an erroneous assumption, and yet an assumption generally made, apparently, that the 9th grade child is essentially different in mental capacity from the 8th grade child. The average 9th grade child is in a transition state, passing from the stage where he was interested in the study of individual facts, lerning them for their own sake, to the stage where he is beginning to be interested in generalizations. All our high-school science is at present highly organized evidently upon the supposition that 9th grade pupils are clearly in the stage of development in which the type study and the generalization are all-sufficient.

At the present time there is developing a strong demand for a general science course in the first year of the high school.

Function of general science course in first-year high school

Those who advocate such a course see many advantages to be gaind by it:

1. Such a course in general science taken by all students during the first year of the high school would greatly reliev the tension of that trying year, thereby lessening somewhat the elimination of students during the high-school period.

2. With the introduction of agriculture and household science into the high schools there has arisen great need of some instruction in physics and chemistry in the first year in order that the work in these applied sciences may be more profitable in the second and third years.

3. At best, it is probable that a large number of high-school students will drop out before completing the entire course. A well-organized general science course will furnish such students with a considerable knowledge concerning some of the most essential facts of science.

4. Such a course would materially increas the effectivness of the instruction in the other and more systematic sciences coming later in the course.

The course in general science for the first high-school year recognizes that the pupil is still largely interested in lerning

about the individual facts of nature for their own sake. The ninth-grade pupil is really interested in seeking and discovering the explanation of natural phenomena, but his interest lies chiefly in satisfying his curiosity regarding that particular phenomenon, and only to a limited degree for the sake of determining a law or arriving at a generalization. Therefore, the course in general science should deal with much the same kind of material as would be suitable for presentation in the upper grades.

Character of the general science course

The usual division of our knowledge concerning the world of nature into sciences such as physiology, botany, zoology, physics, chemistry, meteorology, astronomy, geology, etc., is a division purely for convenience. The botanist and zoologist know that there is no definit dividing line between their two fields; the physicist realizes that his science blends into chemistry, meteorology, physiology, botany and indeed all the other sciences. None of our life activities has to do with the laws and principles of a single science. To know fairly well the story of a tallow candle, the material of which it is made, how it is made and how it burns involvs a knowledge of many of the principal laws of several sciences. Now, in the course in general science there is little or no need of recognizing this artificial division of nature's laws into the sciences. The units of instruction should be chosen from the pupil's environment and each unit should be vitally related to the pupil's life activities or to the welfare of the community of which he is a part.

Some topics suitable for the course in general science

The following topics are suggestiv of the general character of the units of instruction suitable for this course:

1. Lighting

The pine knot } historical
The grease lamp } historical
The candle
The kerosene lamp
    Petroleum and its products
Gasoline lighting
    Properties and dangers of gasoline
Acetylene lighting
Electric lighting
Gas lighting
    Manufacture of coal gas and water gas

2. Heating

Beginning of use of fire, historical
How wood burns
How coal burns
Composition of wood
Composition of coal
Early and modern coal stoves
Composition of air
Oxidation and combustion
Chimneys and convection currents
Jacketed stoves
Furnace heating
Steam heating
Hot water heating

Natural and artificial lighting
Diffused and direct light
Direction and intensity of light
Cost of artificial light

History of cooking devises
Gasoline and gas stoves

It will be noted that the units of instruction here chosen are very different from the units of instruction in the ordinary physics or chemistry text-book. Starting with the facts which the pupils alredy know about each of the sub-units as they are given in the above outlines, the teacher can develop many of the most important laws of physics and chemistry. A ninth-grade class in the hands of a fairly skilful teacher will be able to work out the more fundamentally important physical and chemical principles involvd in either of the above outlines in about three or four weeks. A year's work of this nature will furnish the pupil with a good, practical understanding of applied science as it affects his daily life.

No fixt and rigid course possible or even desirable

It is evident that no course can be outlined for this first year general science which is equally suitable for all schools and all classes. The very purpose of the course is to giv the pupil an understanding of the most important features of his environment and no two pupils or classes hav exactly the same environment. As a basis for the course, however, it is safe to presume that practically all pupils and all classes in any given community hav somewhat similar environment so far as lighting, heating, water supply, wether, climate, foods and food materials, use of simple machinery, helth preservation, and many other topics are concernd. Especially are such topics as arise out of a study of school environment certain to be practically of equal value to all the pupils; moreover, such material is easily accessible. Nevertheless, a school located in an agricultural community needs to use very different material, in general, from that used in a school located in a manufacturing community.

Textbooks outlining this general science course appearing

At present, teachers who feel the need of such a science course as is here suggested feel the need of textbooks which furnish organized material suitable for such a course. Such texts are beginning to appear. The attempts to formulate outlines for such a course, and the choice of material organized in such texts must, of course, recognize the purpose of the course and the general suitability and availability of the material to most schools. The teacher must not expect to find

the course so workt out that the teaching of it makes no more demands upon him than does the teaching of a course in the older establisht sciences. For many years to come, at least, the teaching of a course in general science to ninth-grade pupils will demand the best efforts of the best traind and most skilful science teachers in our high schools. *Where such a course has been given a thoro trial for several years and in the hands of several different teachers, the results achievd richly justify the statement that no more valuable course can be offerd in the high school.*

There is general recognition among science teachers of the fact that our high-school courses in science must be reorganized.

Reorganization of high-school science necessary

There is also recognition of the fact that high-school science is not now receiving anything like the emphasis which its inportance to the majority of high-school students demands. As has been shown in Part I, of this paper, there is no justification for the generally accepted supposition that the ordinary high-school student should be permitted to pursue *but one science study at a time;* i. e., that no more than one-fourth of his time should be devoted to the study of science. No voice is raised against the practis of permitting a student to pursue two or three languages at once. As has been shown in Part I, 50 per cent or more of the enrold students in 1910 were studying each of the three subjects, Latin, English literature, and rhetoric. Even if each of these subjects were offerd in each of the four years of the high-school course, these figures mean that not less than 12 per cent of the total enrolment were also enrold constantly in each of these subjects. Evidently a much larger per cent than this were enrold in at least two of these subjects at the same time. If this is necessary and desirable for those preparing for college, we still should remember that only 5½ per cent are preparing for college. *In the reorganizing of the sciences in our high schools we shall be obliged, if we are to do justis to the pupils who are not preparing for college, to permit two sciences to be pursued at the same time, at least in the later years of the course.*

As has alredy been stated (Part I), we are not at present offering the kind of science in the high school which warrants the expenditure of much larger amounts of time and energy than are now expended. We shall hav so to adapt our science instruction, and the choice of material selected, that the student will receiv training which will be of more practical value to him when he enters upon life's work. It is evident that the science offerd to the 95 per cent of high-school students who are using the high school as a preparation for life's work should have a pretty strong vocational flavor. The physical sciences taught in such a course should not deal extensivly with principles and laws the usefulness of which the student *may* come to appreciate only should he happen to take extensiv advanst courses in the technical school; but the subject matter chosen should deal with laws and principles the usefulness of which the average person in the common walks of life will appreciate.

Character of science instruction must also be modified

To illustrate: In the teaching of electricity, we hav been placing nearly as much emphasis upon static electricity as upon current electricity; nearly every small high school is equipt with a 20-dollar static machine (albeit the instrument is generally out of repair), notwithstanding that there is no adequate means of securing a current for the study of current electricity. Nearly every laboratory is equipt with astatic, tangent and d'Arsonval galvanometers notwithstanding the absense of standard ammeters, voltmeters and watt-hour meters. Even our textbooks giv equal emphasis to all the primary cells, those which hav been of servis to man in days now largely past—the dichromate, the Daniel, the gravity, and the Leclanche—with those of greatest importance today—the dry and the storage cell. The Underwriter's Code, or the National Electric Code governing safe wiring rarely, if ever, finds mention. No time is found for the determination of current consumption and light produced by the common lighting devises. Alternating currents are entirely omitted or barely toucht in high-school texts and courses. The importance of alternating currents is sufficient to demand that some consideration be given them; the difficulty of mastering all the details concerning alternating currents should not deter us from presenting some of the more important and easily taught principles. The failure of our present texts to strike hard at the vitally important topics, and

to omit other topics which are of slight importance, is notisable in many other topics treated. The same criticism can be made of our present texts in chemistry. It is only fair to state, however, that in recent years the new textbooks in both physics and chemistry hav shown decided tendencies in the right direction. The remarkable increas in our knowledge in each of these sciences and the still more rapid increas in useful applications render the task of producing a high-school text which can be coverd in one year by the high-school student a difficult one.

Our present laboratory methods are not the best. The apparatus used in the ordinary high school is often not best suited to teach effectivly the facts and principles involvd. A distinct gain is made by supplanting, in many cases, the specially designd apparatus by apparatus of the commercial type. Many small high schools attempt to do the work as outlined in the ordinary manual with little equipment with which to work. In many instances the teachers in these schools could secure better results by using material of a commercial character easily obtainable in the home market. Apparatus especially designd for laboratory use is much more expensiv than the commercial article. Therefore, when important facts of science can be shown by means of the commercial article it is best to use it. With a good supply of mesuring instruments such as, meter sticks, balances and weights, spring balances, thermometers, volt meters and ammeters, much good laboratory work can be accomplisht with an equipment largely of commercial nature.

Change in laboratory methods needed

The class demonstrations with apparatus of commercial type and on a scale of sufficient size to be easily seen by the members of the class are of high value. Some exercizes of this type which should be more frequently given are the following: (1) determination of horse-power and efficency of gasoline engine, or of the steam engine; (2) determination of horse-power and efficiency of a water motor using water meter and pressure gauge; (3) determination of horse-power and efficiency of electric motor using watt-hour meter; (4) determination of efficiency of several forms of gas and electric lights in common use. The average student will derive much more benefit from a few such exercizes as these having a content worthy of the best effort of any student rather than to spend all his time at individual experiments.

Analytical Summary, Part II

SCIENCE IN THE ELEMENTARY SCHOOL

1. Science instruction is much needed in the elementary school. If well done it puts new life into the school.

2. The teacher in the elementary school to succede need not be a specialist in science, but she should (1) hav a high-school training in science; (2) she should put herself in the attitude of a student; (3) she should hav a clear idea of the purpose of the work; (4) she should lern to study nature at first hand with the pupils.

3. Science in the elementary school is not taught for the sake of developing laws, but to lern the facts of nature for their own sake.

4. Material used in science teaching in the elementary school is simply that of the child's environment.

SCIENCE IN THE HIGH SCHOOL

5. There should be a course in general science given in the first high-school year.

6. The function of the course and the material used should be much the same as that of the elementary school.

7. Textbooks for this course in general science are now appearing.

8. The entire science course for the high school needs reorganizing. In this reorganization much more time should be allowd science than is now given.

9. Much of high-school science instruction should be given a vocational turn.

10. Both textbooks and laboratory work need to be readjusted to meet this new purpose in high-school science instruction.

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10. A two-year special program for teachers of Domestic Science.
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